3.0 ROAD SAFETY AUDIT PROCEDURES

3.1 Road Safety Audit Procedures and Management

The typical procedures involved in conducting Road Safety Audits are shown in FIGURE 3 1 The process is initiated by the project owner appointing or selecting an independent safety team from a qualified pool of recognized experts The design team then provides all relevant documents to the safety team, and a start-up meeting is held among all parties The safety team then reviews all documents, conducts a site inspection and safety analysis, and prepares the audit report A completion meeting among all parties is then held to present and discuss the audit recommendations The design team then responds to the audit report by accepting and adopting selected audit recommendations and by providing written reasons for excluding the remaining recommendations All actions in response to every audit recommendation need to be documented in a written report by the design team Each of these steps is described in more detail in the following sections

In managing a safety audit, a variety of methods provide satisfactory results There is no single "right" method of managing an audit A number of key factors described below can ensure the successful management of a Road Safety Audit

- The audit scope and organization should be clearly specified in the terms of reference
- The safety team should be independent of the design team
- The safety team must have specialist up-to-date knowledge of safety engineering
- The findings of the audit should be formally documented and reported
- The roles and responsibilities of each stakeholder (owner, design team and safety team) should be clearly understood by all parties
- The reasons for various actions resulting from the audit recommendations should be formally documented

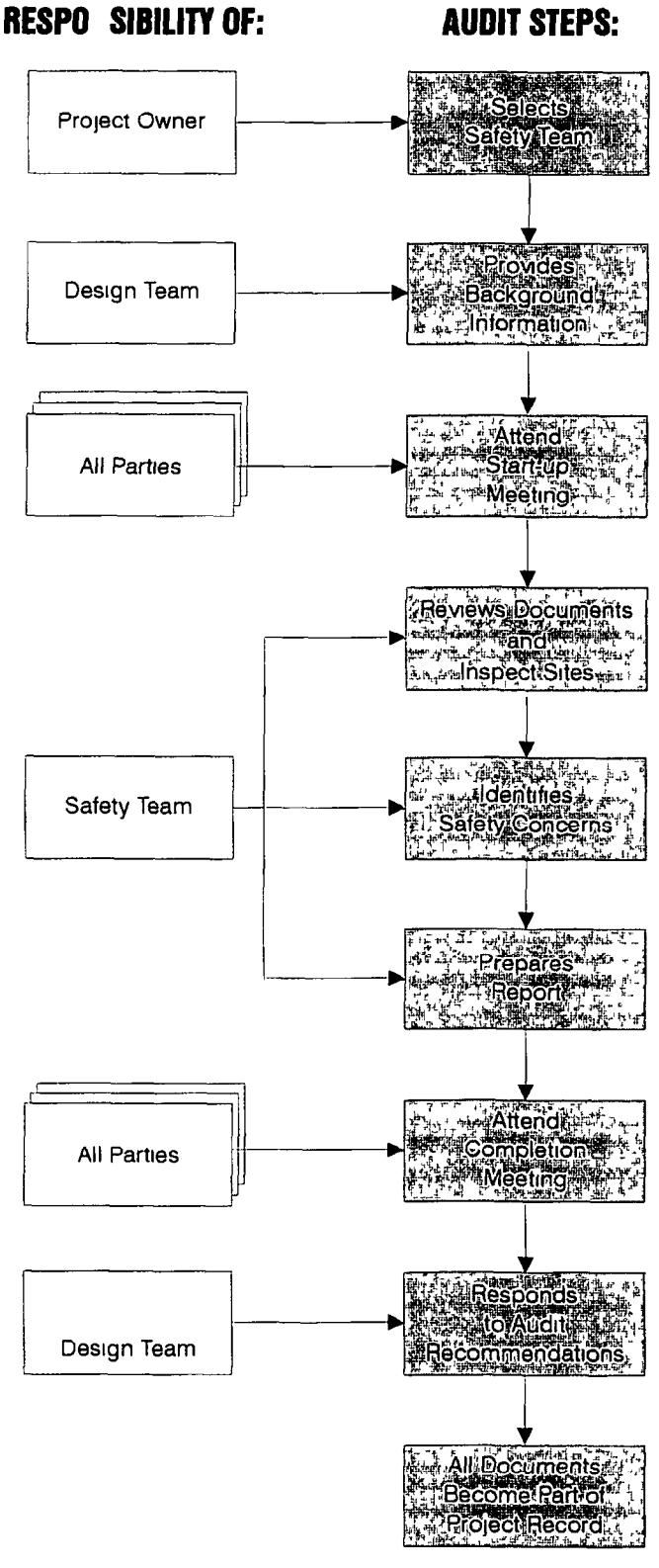

FIGURE 3.1 ROAD SAFETY AUDIT PROCEDURES AND RESPONSIBILITIES

3.2 Safety Team

The project owner typically appoints or selects the safety team, or delegates this responsibility to the design team The safety team must be independent and appropriately skilled The size and type of project typically dictates the size of the safety team The selection of a safety team for various audit stages also varies TABLE 3 1 summarizes the recommended composition of a safety team for each audit stage for a medium size project

TABLE 3.1 AUDIT TEAM TYPICAL REQUIREMENTS
MEDIUM SIZE PROJECT

EXPERTISE	AUDIT STAGE			
	Stage 1 Planning/ Feasibility	Stage 2 Functional/ Preliminary Design	Stage 3 Detailed Design	Stage 4 Pre-opening Stage
Safety Expert	✓	✓	✓	✓
Design Engineer	✗	✓	✓	✓
Other Experts	O	O	O	O
Police	✗	✗	O	✓
Maintenance Engineer/ Technician	✗	O	O	✓

Note ✓ denotes required, O denotes optional, and ✗ denotes not required

A Road Safety Expert should have the following skills.

- a thorough understanding of the relationship between design elements and safety,
- experience in safety engineering principles and practice,
- previous participation on road safety audits,
- full familiarity with the latest road safety engineering research,
- experience in safety management and risk mitigation, and
- preferably experience with collision investigation.

A Highway Design Engineer should have the following skills

- experience with road design standards,
- experience with design practice in the affected jurisdiction; and
- ability to visualize the final design in three dimensions

Other specialist skills (depending on the nature of the project) may include

- traffic signal control,
- Intelligent Transportation System (ITS) technologies,
- human factors,
- commercial vehicles;
- cyclist and pedestrian facilities;
- transit systems and facilities,
- traffic calming; and
- street lighting.

The Police Officer should have experience in traffic management and collision investigation

The Maintenance Engineer or Technician should have experience in the maintenance and operations of similar roads

3.3 Background Information Requirements

All the relevant information should be provided to the safety team to allow for an adequate assessment of the project It is the responsibility of the design team to collect all the necessary and relevant reports, data, drawings and contract documents for the safety Team. This step should be initiated well before the commencement of the audit to avoid delays. Typically, the background information includes

A. General Information

- project scope, goals and objectives,
- methodology, standards, and design criteria used,
- any deficiencies which need to be reviewed,
- prior community input and consultation;
- relevant background reports, and
- any proposals for relaxations or departures from design standards.

B. Site Data

- collision data,
- traffic volumes including pedestrians and cyclists,
- known safety issues; and
- key environmental, geotechnical, right-of-way and socio-economic issues and constraints

C. Plans and Drawings

- drawings showing vertical and horizontal alignment and cross-sectional elements;
- other relevant design items with respect to the Audit stage; and
- other plans showing adjacent roads and land that may be affected by the project

3.4 The Start-up Meeting

Before undertaking the audit, it is necessary for the design team to familiarize the safety team with the project background A start-up meeting will provide this opportunity to discuss the project background and any safety issues, exchange information, assign responsibilities, and establish communication channels The terms of reference to define the scope of the audit, as specified by the project owner should be finalized at this meeting Details such as project schedules and any special requirements should be included at this stage

3.5 The Audit Process

After the start-up meeting, the audit process of assessing the documents and site inspections will commence. The following steps describe typical procedures for the planning, preliminary design and detailed design stage audits:

STEP 1 The safety team examines in detail all the background and design information provided. Typically the project is audited in a section by section basis to fully consider the impact on different road users A preliminary list of potential safety issues should be identified at the end of this step Any preliminary recommendations likely to improve safety should also be generated at this point.

STEP 2 The team should conduct a site visit for both existing roads and "green field" projects The site inspection is essential, and provides an overall picture of the conditions. During the site visit, the team should pay particular attention to the transition of the project to the existing road network to ensure consistency from the perception of road users, to visualize the proposed design and impacts, and prevailing climatic and geographic conditions. The inspection should be conducted from the perspective of all potential road users, in particular vulnerable users, elderly drivers and truck drivers

STEP 3 The document assessments and field work are analyzed, reviewed and integrated, using checklists as appropriate, to ensure all relevant aspects have been covered Traditionally, checklists have been used to aid the safety team in conducting audits Detailed checklists are available from the Road Safety Audit report, published by Austroads The latest United Kingdom publication Guidelines for the Safety Audits of Highways by the Institute of Highways and Transportation has de-emphasized the use of checklists, and provided significantly less detailed ckecklists than Austroads. In conducting an audit, the safety team should avoid an over-reliance on checklists, which can result in a "plan checking" mentality, diminishing the value and effectiveness of the audit. The safety team should apply its expertise to conduct the audit from the road users' perspective, by visualizing road conditions and expertly analyzing the multitude of factors which can affect safety in combination

Any potential safety issues should be identified at this stage It is important that the audit confines itself to safety issues only Other aspects such as capacity, amenity or aesthetics, unrelated to safety, should not be addressed by the audit.

STEP 4 The audit report should be prepared The audit report should clearly and succinctly identify participants, process, issues and recommendations The recommendations are usually conceptual in nature, rather than specifying the details of a solution. The report documents the safety concerns as a basis for corrective decisions or justification by the design team.

For Stage 4 audits (pre-opening), the main task is to conduct a site inspection, and the procedure is described as follows.

STEP 1 Review all previous audit reports and other relevant information

STEP 2 Review the physical characteristics of the project site to identify potential problems through a site inspection. The inspection should include driving and walking through the project from different directions, and considering requirements for vulnerable users If possible, the inspection should also be conducted at night and for adverse weather conditions. Particular attention should be paid to the positioning of street furniture, signs and pavement markings The most likely safety issues to be identified at this stage include features that adversely affect the road users' perception of the road or restricted sight lines. This step should be undertaken as close as possible to opening and allowing time for any necessary changes to be implemented For larger size projects, the pre-opening audit may be conducted in phases, as sections of the project are completed.

STEP 3 A preliminary report of the pre-opening audit should be submitted to the design team as soon as possible to overcome any time constraints to implement corrective measures. At the same time, a final report should be prepared documenting the full procedures and findings of the audit

3.6 Audit Recommendations and Response

Responding to the audit report should be the responsibility of the design team. A meeting involving the safety team and the design team, preferably in the presence of the owner, should be held at the completion of the audit. The objective of this meeting is to address the audit recommendations in a constructive manner It is important that this meeting commence with a reiteration of the dedication of all parties to enhance safety, and to proceed with the meeting in a cooperative and constructive spirit. The discussion should be concentrated on the recommendations for any corrective measures or actions. Each recommendation of the audit report can either be accepted or rejected

For each accepted recommendation, feasible corrective measures should be identified and adopted by the design team The redesign should then proceed to overcome or reduce the safety hazard. Once the redesign is complete, the redesign may be submitted for a further audit For each rejected recommendation, the reasons for rejection (whether physical, economic, or social) should be provided and documented in writing The design team should document in a written report the action for every recommendation in the audit report Both the audit report and the design team's response become part of the project record.

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4.0 DESIGN SAFETY REVIEW PROCEDURE

4.1 Design Safety Review Management

The management of a Design Safety Review is similar to that of a Road Safety Audit The most critical success factor is the independence of the safety team. The organization of the design team and the safety team should be structured in a way not to compromise the independence of the safety team In a Road Safety Audit, the safety team is involved after design milestones are completed, while the safety team is involved from the beginning of the design process in a Design Safety Review. The safety team should keep in mind that issues other than safety should be left to the design team The function of the safety team is to provide safety expertise to the design team, and to review the design from a safety perspective only From the beginning of the project, the role of the safety team should be clearly defined. It may also be desirable for the safety team to have a direct communication channel with the project owner to resolve any potential conflict or problems

4.2 Selecting the Safety Team

The safety team should possess similar qualifications as described in Section 3 The composition of the safety team is similar to that of an audit for various stages as described in Section 3

4.3 Background Information Requirements

The relevant background reports and drawings should be provided by the design team from the onset of the review As the Design Safety Review is an on-going process, relevant information should be provided by the design team to the safety team as soon as it becomes available.

4.4 The Start-up Meeting

A start-up meeting should be held involving all parties to establish roles and responsibilities. Communication channels and protocols should also be established at this time In a Design Safety Review process, the start-up meeting could be the same as the start-up meeting for the overall project, where the Safety Team can be introduced to all the other experts participating on the project, such as the environmental and geotechnical specialists.

4.5 The Design Safety Review Process

The process for Design Safety Reviews is more informal than an audit, thus providing more interaction and communication between the safety team and the design team This added flexibility may be more desirable for projects under time constraints Safety issues that arise during the design process may be resolved quickly, and various corrective measures may be discussed and ideas exchanged, fostering consensus and a spirit of cooperation among the project team.

The process for Design Safety Review involves the design team referring to the safety team any safety issues or compromises *as they arise* in the design process. The safety team then quickly reviews the issue and provides a recommendation from a safety perspective back to the design team It remains the responsibility of the design team to integrate the recommendation of the safety team into the design. While it is mainly the responsibility of the design team to refer safety issues for review by the safety team, by participating in the project meetings, the safety team may also identify and bring up issues worthy of review from a safety perspective This is therefore a continuous and on-going process in which the safety team addresses the safety issues of the project as these issues arise. The communication between the design team and safety team is recommended to be in writing, to establish an on-going record of decisions and recommendations made.

4.6 Documentation

At the end of the project, it is recommended that the safety team produce a safety report to document all the issues addressed and recommendations made. This will provide a record of the safety enhancements which were suggested to the design team As an option, a Road Safety Audit may still be conducted at the design milestones In such case, it is recommended that a new safety team independent of the team which conducted the Design Safety Review be brought in to conduct the audit.

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5.0 DESIGN/BUILD PROJECTS

5.1 Characteristics of Design/Build Projects

Design/Build projects (otherwise known as public-private partnership projects) approach the provision of infrastructure in a partnership paradigm. Design/Build is a method of project delivery in which one entity (the private sector design-builder) forges a single contract with the owner to provide engineering design and construction services Greater efficiency is achieved through working in partnership by maximizing the abilities and skills of each partner Variations of design/build projects include Design/Build/Operate (DBO), Design/Build/ Operate/Transfer (DBOT), and others Design/Build projects typically have the following characteristics

- *Risks and Responsibilities Transfer* - A significant level of risk and responsibility is transferred from the public sector to the private sector
- *Performance-based Outcome* - Contractual agreements are typically built around performance-based outcomes, rather than work activities
- *Alternate Means of Financing* - Design/Build projects have the potential to use non-traditional sources of financing such as tolling
- *Partnership Between Public and Private Sector* - rather than the traditional "arm's length" relationship, a partnership style approach is used

Design/Build projects are typically constructed on an accelerated schedule, and result in substantial cost savings As the public sector is becoming more fiscally responsible, the prospect for design/build projects for highways is becoming increasingly more viable to address the need for road infrastructure

A number of highway infrastructures were recently completed in British Columbia and Canada using the design/build approach·

- Westview Interchange, British Columbia,
- Johnson-Mariner Connector, British Columbia,
- Highway 407, Ontario; and
- Northumberland Strait Crossing Project, New Brunswick.

A number of local projects in the Lower Mainland are planned for construction potentially using the design/build approach:

- South Surrey Interchange, and
- Sea Island/Airport Connector.

As the risks and responsibilities are transferred to the private sector in this type of projects, it is critical that road safety be made an integral part of the design/build process. Audits or reviews need to be built into the design/build process as part of the quality management.

5.2 Audits and Reviews for Design/Build Projects

When undertaking a design/build project, the road authority can address road safety explicitly by stating the requirements for a Road Safety Audit or Design Safety Review in the contract documents or terms of reference. As part of the requirement for the design/build project, the proponent should commit to conducting an independent Road Safety Audit or Design Safety Review on the proposed design

The audit or review procedures as outlined in previous sections may be followed. The independent safety team audits or reviews the design work, and prepares a written report for the design team. Upon reviewing the report, the design team then prepares a written response outlining the design changes in response to the report recommendations, or the reasons for excluding the recommendations All documents become part of the project record

Design/Build project typically streamline the design process The preliminary design is prepared at the proposal stage The successful proponent team proceeds to detailed design immediately upon award. It is therefore essential that the safety team be involved with the private sector design team very early in the project, at the project proposal stage

5.3 Roles and Responsibilities

A. Road Authority

Depending on the nature of the design/build project, the road authority's responsibilities include

- preparing the terms of reference to include an audit or review,
- reviewing the proposals by the proponents, and
- reviewing the documentation of the audit or review.

B. Safety Team

In design/build projects, the safety team's responsibilities include:

- the evaluation of the safety performance of the proposed design, and
- the preparation of an independent written report documenting audit or review recommendations with a focus on safety only

C Proponent

The proponent should.

- ensure the independence of the Safety Team in its organizational structure;
- initiate the audit or review process,
- retain an independent safety team,
- provide all relevant information to the safety team,
- ensure that the audit or review is conducted to a high quality standard,
- receive and review the audit or review report,
- respond to the report and document the responses,
- conduct any redesign work as a result of the audit or review findings,
- allow an appropriate amount of time for the audit or review;
- allow for all costs associated with the Road Safety Audit or Design Safety Review, including any redesign fees resulting from the audit or review recommendations; and
- provide all documentation related to the Road Safety Audit or Design Safety Review for review by the road authority.

6.0 VALUE ENGINEERING AND SAFETY

6.1 Value Engineering

Value engineering is defined as *the application of the scientific method to the study of values of systems* by the Standard Handbook for Civil Engineering The major objective of value engineering as applied to civil engineering projects is the reduction of initial and life-cycle costs Traditionally, design standards and criteria have often been made less stringent in the process of value engineering, while safety is only implicitly considered or addressed in the evaluation process Value engineering, in the context of highway design, should evaluate the level of safety resulting from relaxations in design configurations against existing standards Due to short-term budget pressures, value engineering is sometimes reduced to a simple cost-cutting exercise As such, road safety is often overlooked or compromised.

Value engineering is typically conducted at the end of the design process. Road safety may be compromised when value engineering is conducted after a Road Safety Audit or Design Safety Review if the value engineering recommendations are not fully assessed for safety impacts Any safety enhancements incorporated in the project in the safety audit or review may also be compromised or reversed during the value engineering process

6.2 Addressing Safety in Value Engineering

Assessing the safety implications of value engineering recommendations should be an integral part of projects subjected to value engineering. Ideally, the safety assessment needs to be conducted *after* the value engineering exercise. Road Safety Audits should be used to assess fully and explicitly the safety implications of the value engineering recommendations

As a minimum, a safety specialist should be included as part of the value engineering team to assess the safety implications of the modified design due to the value engineering proposal Experience in both Ontario and British Columbia has indicated that value engineering decisions frequently jeopardize safety, and that a safety review of these decisions is essential

6.3 Roles and Responsibilities

A Safety Expert as Part of the Value Engineering Team

It is recommended that, as a minimum, a safety expert be included as part of the value engineering team The role of the safety expert is to review and highlight the safety implications of value engineering proposals, and to quantify life cycle costs and benefits from a safety perspective Project owners should ensure that the safety expert is part of the value engineering team, and the value engineering coordinator should be made aware of the safety expert's special status as part of the value engineering process.

B. Safety Review of Value Engineering Recommendations

Ideally, a Safety Audit or Review should be conducted after value engineering recommendations are finalized and adopted Project owners should retain a safety team to audit or review and quantify the safety implications of the value engineering recommendations Value Engineering proposals may be rejected at this stage if a significant adverse effect on safety is identified by the safety team A written report should be prepared by the safety team to provide documentation of the process, quantification, and recommendations to the project owner.

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